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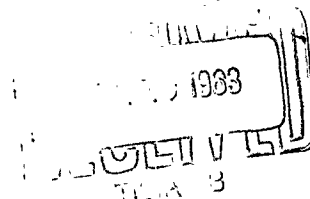
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A PHYSIOLOGICAL EFFECT OF COGNITIVE DISSONANCE  
UNDER STRESS AND DEPRIVATION

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## ABSTRACT

An experiment and a partial replication were conducted to relate the change of motivation due to dissonance reduction and commitment to physiological changes. The experimental technique was based on food deprivation studies by Brehm which showed that already deprived individuals who committed themselves to further fasting under conditions of low reward decreased their self-estimates of hunger, while the reverse was true for those given high rewards. In the present study the further deprivation was actually executed, and a physiological measure, the concentration of plasma free fatty acids (FFA), was taken. This has been shown to be a reliable measure of autonomic nervous system activity in response to increased energy demands upon the individual, such as length of fasting.

Results showed that the subjects who were relatively hungry during commitment showed increase in FFA during the additional hunger period. Another measure which could be derived was the ratio of FFA at puncture to a later resting level (indicative of situational stress). This ratio decreased for subjects in the high dissonance condition and increased for those in the low dissonance condition. In the replication study the same pattern emerges in change of resting level and in the measure of situational stress. There is some indication that the subjects in the replication were initially more committed to the study which shows up in the differences between initial blood samples between the two studies.

The data indicate that a person who has convinced himself that he is not so hungry tends to respond physiologically as if he were not hungry. Physiological aspects of a more enduring process, such as hunger motivation, are also affected by justification in a manner consistent with dissonance theory.

## A PHYSIOLOGICAL EFFECT OF COGNITIVE DISSONANCE UNDER STRESS AND DEPRIVATION

Mary L. Brehm, Kurt W. Back and Morton D. Bogdonoff

For a hungry individual, the perception of hunger would be dissonant with a voluntary commitment to further deprivation. He may resolve this dissonance by making his perceptions consonant with his commitment, i.e., by reducing his perceived hunger. Moreover, according to dissonance theory, the magnitude of dissonance is inversely proportional to the amount of extrinsic reward or justification for the commitment. Thus, to the extent that there are extrinsic reasons for the commitment to deprivation, little dissonance is aroused and there is little pressure to reduce perceived hunger.

In two deprivation studies by Brehm (1962), already deprived individuals were asked to volunteer for an extended period of food or liquid deprivation under conditions of either high or low payment. It was found that those subjects who committed themselves under conditions of low reward tended to decrease their self-estimates of hunger or thirst following the commitment. The reverse was true for those given relatively high rewards.

In discussing these findings, Brehm and Cohen (1962) suggest that non-cognitive components of motivation may react in a concurrent fashion. It is precisely this aspect of motivation that the present exploratory studies intend to examine: Are cognitive changes produced by dissonance reflected in physiological variables, on the level of changes in motivation, and tolerance of a stressful situation.

A study was designed which allows examination of certain cognitive and physiological changes as a function of commitment to further deprivation and exposure to stress under high and low dissonance conditions. The deprivation period was 24 hours, which permits examination of possible relatively enduring dissonance effects. The physiological measure required taking blood samples,

a fear-arousing situation, which made possible an examination of physiological reactions to situational fear arousal as a function of dissonance.

The physiological measure used was the change in concentration of plasma free fatty acids (FFA). The mobilization of FFA has been shown to be a reliable measure of autonomic nervous system activity in response to increased energy demands upon the individual, such as length of fasting, which correlates positively with FFA level (Dole, 1956; Klein, Bogdonoff, Estes, Shaw, 1960). The measure is also highly responsive to central nervous system activity. In arousal situations, such as introduction of the needle to take the blood sample, sharp rises in FFA occur, followed by a return to the basal rate after a short recovery period (Bogdonoff, Estes and Trout, 1959; Cardon and Gordon, 1959). It also has shown itself to be sensitive to conditions of social interaction (Back, Bogdonoff, Shaw, and Klein, 1963).

Dissonance theory holds that dissonance and consequent minimization of hunger increases as justification for committing oneself to deprivation decreases. Since FFA is directly related to length of deprivation, and presumably hunger, one might expect that subjects who committed themselves to deprivation for little justification and who therefore convince themselves they are not hungry would show less increase in FFA than those given high justification. Similarly, since FFA increases from the stress of puncture, subjects who commit themselves to a second puncture under low justification and presumably try to minimize the fearfulness of the puncture would tend to show less arousal at the second puncture.

#### Procedure

Subjects were undergraduate men recruited through introductory sociology classes. They were told that the experiment would involve fasting and blood samples, and three credit points were offered for participation. In the after-

noon prior to the experiment, Ss in groups of three to six reported to the hospital clinic for a briefing session. Size of the group was determined only by clinic scheduling problems. The Ss were told by the experimenter (a physician) that they must maintain a strict fast from that time (4:30) until the following morning. In order to emphasize the importance of the fast, they were given wafers supposedly containing a traceable chemical element which would reveal any intake of caloric substances. The purpose of the experiment was minimally described as "an examination of blood chemistry in normal young males following a fast of 17 hours."

On arrival at the clinic at 8:30 the following morning, a research technician first asked the Ss to rate themselves as to "how hungry they felt at the moment." Ratings were made on a 61-point scale, labeled each tenth point by "Not at all," "Very Slightly," "Slightly," "Moderately," "Quite," "Very," and "Extremely." They were asked to be as accurate as possible in marking the dot closest to their feeling of hunger. An indwelling Cournand needle was inserted in an antecubital vein and the first blood sample drawn. This sample will be referred to as the puncture level. A recovery period of 20 minutes elapsed wherein Ss sat quietly filling out questionnaires including measures of social desirability, anxiety and semantic differential items. The information from these questionnaires was used in conjunction with a separate study and was used here primarily to provide a standard time and activity prior to taking the second, or resting, blood sample. Since their analysis is not germane to the present study, they will not be discussed further, beyond remarking that no differences between experimental conditions were found. During this time, samples of packaged foods, sandwiches, candy, cookies and milk, were on obvious display in the experimental room.

After drawing blood sample 2, Ss were seen individually by the physician-

experimenter. In the Low Justification (high dissonance) condition, the experimenter introduced himself, briefly reiterated the ostensible reason for the experiment, and asked the subject whether he would be willing to continue the fast for another eight hours. He reassured the subject that his commitment to the experiment was completed, that he already had earned his credit points, and that further continuance was up to him and merely a convenience to the research team "to gether additional data on a full 24-hour fast." If the subject hesitated, he was told that it was entirely his choice, but scheduling problems would be alleviated if he could continue.

In the High Justification (low dissonance) condition, Ss were likewise told that their commitment to the study was completed, but that it was highly important to medical research, to science, and to the success of the project to get additional data and that the study was therefore willing to pay a stipend of \$25 for a further eight-hour period of fasting. In both conditions the necessity of not discussing the experiment on campus was stressed.

For both conditions, upon compliance, a third blood sample was drawn and the needle was removed. The technician again asked the subject to rate his state of hunger on a separate identical scale. He was told that people change in the way they feel, even in the space of an hour, some changing one way, others another and some not at all, and that he should again be as accurate as possible. He was then asked to order items of food such as those displayed to be available at his return for the afternoon session.

On return to the clinic at 4:30 that afternoon, Ss were again asked to rate themselves on the hunger scale. Needles were inserted and the puncture-level sample drawn. A period of 20 minutes elapsed of filling out questionnaires similar to those administered in the morning. The fifth and last sample was drawn and needles removed. This concluded the experiment. While eating



what food they had ordered, Ss were fully apprised of the nature of the research, and all, regardless of expectation, were given the monetary reward. Blood samples were analyzed for free fatty acid by a modification of the method of Dole (Trout, Estes and Friedberg, 1960), and the unit of measurement is reported in terms of  $\mu\text{Eq/L}$  (micro-equivalent per liter).

Subjects were assigned randomly to the two conditions. Of the 20 Ss recruited, nine were assigned to the High and eleven to the Low Justification conditions. Three Ss, two in Low and one in High Justification, declined further commitment because of prior arrangements. Two Ss in Low Justification committed themselves and failed to return in the afternoon. There were thus eight High and seven Low Justification subjects.

Blood sample 3 was taken to determine whether there was any immediate response. However, only a few minutes elapsed between the S's commitment and the drawing of this sample. This proved to be too short a period to produce any stable difference between that sample and the resting level. Other studies in lipid research have also shown that 15-20 minutes is required for the FFA reaction. Therefore, sample 3 will not be used in the analysis. It should also be noted that there is no apparent theoretical reason why the groups would differ on the third measure of hunger, since at the time this rating is taken, immediately prior to eating, all Ss are in essentially the same psychological condition.

### Results

Table 1 presents the mean scores for the three self-ratings of hunger.

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INSERT TABLE 1 ABOUT HERE

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Differences between conditions are not significant in the morning ratings, but Low Justification subjects tend to have higher ratings in the afternoon ( $p = .10$ ,

Mann-Whitney test, two-tailed). This is apparently a function of initial differences, since changes in ratings from morning to afternoon are not significantly different. However, the groups differ in change of ratings immediately following commitment. Five out of seven Low Justification Ss decreased their ratings of hunger, whereas only one of the eight High Justification Ss did so ( $p < .10$ ). This one S complained of nausea following the drawing of the second blood sample and subsequently decreased his hunger rating by 18 points. Without this subject, the difference between conditions in hunger change is significant at the 2 per cent level. It appears, then, that the amount of reward used to induce commitment has affected the degree of felt hunger immediately following the commitment. However, no changes from morning to afternoon are significantly different between conditions.

Mean FFA levels of the five samples are shown in Table 2. Direct comparison

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INSERT TABLE 2 ABOUT HERE

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of the samples between conditions indicates no significant differences. The first index to be examined is the change in resting level from morning to afternoon, samples 2 and 5. It may be seen from Table 3 that there is no difference

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INSERT TABLE 3 ABOUT HERE

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between conditions. However, in the thirst study by Brehm (1962), Ss rating themselves as less than "Slightly" thirsty were deleted from the analysis, "because these subjects could hardly be expected to experience dissonance from committing themselves to further deprivation as long as the initial deprivation had not made them thirsty. For these subjects, there was nothing dissonant with commitment to further deprivation." (Brehm and Cohen, 1962, p. 139). In the present study, when Ss are divided on the basis of a median split on initial

hunger, in the Low Justification condition, those who are relatively hungry show less increase in FFA from morning to afternoon ( $t = 1.04$ ,  $p < .10$ ). This is not an artifact due to initial levels of FFA since Ss in the High Justification condition do not show the same effect (interaction  $F = 3.29$ ,  $p < .10$ ). Thus Ss who presumably experience the most dissonance, namely those in the Low Justification condition who were hungry at the time they committed themselves to further deprivation, show the least increase in FFA during the period of deprivation. This is, of course, what would be expected if they were successful in convincing themselves that they were not very hungry during the period of deprivation, and if this self-persuasion has a corresponding effect on physiological variables.

The second measure is an index of the S's reaction to the needle puncture, the ratio of puncture to resting level, sample 1 divided by 2 for the morning, and sample 4 by 5 for the afternoon session. These data are presented as percentages in Table 4. It can be seen that Low Justification Ss became less

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INSERT TABLE 4 ABOUT HERE

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aroused in the afternoon, while High Justification Ss became more aroused. An analysis of variance yields an interaction  $F$  of 5.91 ( $p < .05$ ), with non-significant main effects. Again, if one divides the group on the basis of the dimension relevant to dissonance, in this case initial arousal (sample 1 divided by 2), it is clear that the difference between conditions occurs only with those Ss who exhibited greater tension at the threat of needle puncture, as can be seen in Table 5. The figures represent the difference between the morning and

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INSERT TABLE 5 ABOUT HERE

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afternoon ratios, a minus indicating decreased situational arousal. Thus, sub-

jects who commit themselves to a fearful and hence physiologically arousing situation tend to show less subsequent physiological arousal to the extent that justification for the commitment is minimal and dissonance presumably high.

In summary, the evidence indicates that physiological arousal to a fearful situation is clearly affected by dissonance. That the same physiological response is a function of dissonance-produced changes in hunger over a deprivation period of several hours receives only weak support.

#### A Replication

To increase the size of the sample, the study was repeated with two modifications. In order to make the results more generalizable, individual monetary reward was omitted from the High Justification condition. In addition, a Full Day condition was run wherein Ss anticipated the total length of the fast and were exposed to the High Justification rationale for the experiment. The procedure was essentially the same as in the previous study.

Subjects were recruited through campus organizations which were paid a standard amount for enlistment of members. Hence volunteering for the experiment was in part a function of loyalty to the organization. For extraneous reasons, it was necessary to make the experiment sound more attractive in order to get volunteers. Subjects thus may have been more involved in the experiment from the beginning, a point which will be discussed later. Eleven in each of the Justification groups and seven Full Day Ss were run. Commitment was obtained from all 22 Justification Ss and all Ss returned for the afternoon session. One subject was deleted from the Low Justification group owing to an inadequate fast prior to the morning session. One High Justification subject suffered a syncopal reaction in the afternoon, and his blood measures were deemed unreliable.

## Results

Table 6 presents the mean hunger ratings for the three groups. None of the differences between groups is significant, and it is apparent that the pre-

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INSERT TABLE 6 ABOUT HERE

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dicted decrease following commitment did not occur. Moreover, initial ratings in all three groups are considerably lower than in the first study, nine of the Justification and two Full Day Ss rating themselves as slightly hungry or less.

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INSERT TABLE 7 ABOUT HERE

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Mean FFA levels are presented in Table 7. It may be seen that sample 1 for the High Justification condition is unusually low and is, in fact, lower than the resting level. Because of the low levels of hunger ratings, the apparent failure of the dissonance manipulation and the unusual pattern of blood levels in one condition, the results will be presented in less detail and an attempt will be made to explain the contrast between the studies.

The same pattern emerges as in the previous study on the measure of morning to afternoon change in resting level, with initially hungry, Low Justification Ss increasing less than comparable High Justification Ss, and the reverse for initially not hungry Ss (an analysis of variance yields a significant effect for hunger, and a significant interaction). However, there is no difference between the hungry and not hungry Ss in the Low Justification condition, and the interaction effect is a function of the significant difference between the hungry and not hungry Ss in the High Justification condition. There was a similar effect, though not significant, in the first study. Why, among Ss given justification, those who are less hungry would show less increment in FFA is not clear. It is, of course, plausible that those who feel relatively less

hunger actually do have less need for mobilization of FFA during the period of deprivation. The Full Day Ss respond in just this fashion. Thus, the relative reversal of the Low Justification condition in this study and the absolute reversal in the first study might be taken as strong evidence that hungry Ss in the Low Justification conditions are responding to dissonance.

On the measure of situational stress, analysis of variance between the Justification conditions yields a significant interaction at the 5 per cent level and no main effects. This is consistent with the findings of the first study, with Low Justification Ss showing better tolerance of the stress and High Justification Ss becoming more aroused. However, this measure utilizes the initial blood level, and these results could be merely an artifact of the apparent sampling error exhibited in initial differences. This makes any interpretation of the results difficult. The Low Justification Ss show a decrease of 29 per cent among the initially aroused and a 17 per cent increase for those not aroused. Full Day Ss decrease 37 per cent if initially aroused, 13 per cent if initially not aroused.

#### Discussion

The first question posed in this research was whether the cognitive reorganization produced by dissonance is accompanied by physiological changes following commitment to further deprivation. In the first study Ss who initially reported themselves as hungry and committed themselves under conditions of minimal justification show the least increase in fat mobilization over the extended period of deprivation. A similar pattern was observed in the second study, though this must be qualified in that the possibility cannot be excluded that the apparent sampling error producing initially low levels of arousal in the High Justification condition may be related to the resting level.

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On the measure of situational arousal, or reaction to the stress of needle puncture, Low Justification Ss in both studies show increased tolerance, and this is especially apparent with those Ss to whom the stress was most relevant, i.e., those who show initially high levels of reaction. Full Day Ss show a decrease regardless of initial arousal. This is reasonable in that these Ss were not given any further choice, so that the amount of initial stress they experienced would be irrelevant to their prior commitment to repeated stress. For both studies, a reversal occurs in the High Justification condition, with Ss showing increased arousal to the afternoon puncture. However, we must again qualify these findings in the second study owing to the initial differences in puncture level..

Some interesting questions are raised by the differences between the studies. Not only did the dissonance manipulation fail to produce cognitive changes immediately following commitment in the second study, but the pre-commitment blood levels for the Low and High Justification conditions are a great deal lower than in the first study. The difference in blood sample 1 is significant at the 2 per cent level, and sample 2 differences fall just short of the 10 per cent level. Also, the initial hunger ratings were lower in the second study. With these relatively low initial hunger and FFA levels, it would be theoretically consistent to suppose that subjects in this study were all in a state of high dissonance. This could be true if they had a relatively great number of dissonant (negative) cognitions about participating in the study, or if they held a relatively small number of consonant (positive) cognitions about participation. This view does not seem plausible, however, since the negative information they were given (concerning the deprivation and taking of blood samples) was no greater in the second study than in the first, while the positive information was probably greater for study two than for one, because in two a greater attempt was made to make the study

appear to have scientific and practical importance. It must be admitted, however, that there are no data to back up this impression held by the authors.

Another interesting possibility is that cognitive reorganization in support of one's commitment tends to occur to the extent that one is highly motivated to engage in whatever one commits oneself to. Thus, as specified by dissonance theory, a person may become highly motivated when confronted with a choice of great importance. But apart from dissonance theory, and somewhat at variance with it, a person may also be highly motivated to engage in a given behavior by a strong "pitch" or selling job, as when personal, societal, and scientific benefits are stressed. In brief, then, a person may reorganize his cognitions in support of his behavior not only in response to dissonance, but also, and more generally, whenever he is highly motivated to engage in that behavior.

Katz (1960) has distinguished several functions of attitudes and motivation. Fulfilling the need for consistent knowledge is one of them and leads to dissonance reduction during the experiment session itself. In recruiting for the second study we used a value-expressive function, as volunteering to fast was an expression of loyalty to the campus group which would get paid. Reorganization of cognitions related to this function resulted in greater motivation throughout the experiment.

Whatever the shortcomings of the second, the first study indicates quite clearly that a physiological response to stress is affected by justification in a manner consistent with dissonance theory. It should therefore be true that the relationships between other kinds of stress situations and other physiological variables sensitive to stress would be affected similarly. For example, an individual's galvanic skin response would presumably be minimized under conditions of low justification (or low incentive, etc.) for commitment to electric shock. In general, to the extent that a stressful situation arouses dissonance,



physiological indices of stress should tend to reflect attempts at dissonance reduction.

The first study, and to a lesser extent the second, also provided evidence that the physiological aspects of more enduring processes, such as hunger motivation, are also affected by justification in a manner consistent with dissonance theory. Specifically, these data suggest that a person who commits himself to deprivation when already motivated experiences dissonance and consequently attempts to minimize the magnitude of his motivation. As has been shown in previous work (Brehm, 1962), within a few minutes a person tends to report he is less motivated than he had reported prior to commitment. The present data indicate that this self-convincing process goes beyond cognitive change and does, in fact, result in the modification of a physiological response known to be related to the type of motivation involved. That is, having convinced himself that he is not so hungry, the individual responds physiologically as if he were not so hungry (so deprived). To the extent that this finding, here only marginal, holds up, it has rather widespread implications for the understanding of motivational phenomena.

The results of this research strongly indicate the value of further theoretical and empirical exploration along these general lines. On the one hand, it is necessary to search out the cognitive variables which are relevant to important physiological processes, and to determine the forces, such as dissonance, which may affect them. On the other hand, the power of these cognitive variables to affect their physiological counterparts must be thoroughly tested.

Table 1

MEAN RATINGS OF HUNGER

Ratings	Condition	
	Low Justification	High Justification
Morning:		
1. Pre Commitment	35.1	29.5
2. Post Commitment	33.1	29.4
Afternoon:		
3. Final Rating	40.1	36.0

Table 2

MEAN FFA LEVELS ( $\mu\text{Eq/L}$ )

Samples	Condition	
	Low Justification	High Justification
Morning:		
1. Puncture	1155	960
2. Resting	729	776
3. Post Commitment	777	774
Afternoon:		
4. Puncture	1405	1586
5. Resting	1224	1212

Table 3

MEAN FFA INCREASE AM TO PM

Condition	Initially Hungry	Initially Not Hungry	Total
Low Justification	316	733	495
High Justification	523	384	436
Total	405	515	464

Table 4

PER CENT PUNCTURE OF RESTING LEVEL

Condition	Morning	Afternoon	Total
Low Justification	157 %	112 %	135 %
High Justification	124	132	128
Total	139	123	131

Table 5

DIFFERENCE IN AROUSAL RATIOS

Condition	Initially Aroused	Initially Not Aroused	Total
Low Justification	-70 %	-10 %	-45 %
High Justification	13	4	8
Total	-29	-2	-16

Table 6  
MEAN RATINGS OF HUNGER

Ratings	Condition		
	Low Justification	High Justification	Full Day
Morning:			
1. Pre Commitment	29.3	21.6	26.4
2. Post Commitment	31.8	25.1	29.4
Afternoon:			
3. Final Rating	47.7	41.5	44.7

Table 7

MEAN FFA LEVELS ( $\mu$ Eq/L)

Samples	Condition		
	Low Justification	High Justification	Full Day
Morning:			
1. Puncture	795	568	835
2. Resting	692	609	671
3. Post Commitment	616	556	642
Afternoon:			
4. Puncture	1664	1426	1379
5. Resting	1518	1290	1379



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